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November 18, 1976

Attached is a draft Environmental Impact Statement (EIS) for a proposed bentonite mine near the town of Alzada, Carter County, Montana. On August 5, 1976, American Colloid Company of Skokie, Illinois applied to the Montana Department of State Lands for an Open Cut Mine contract on Sections 1 and 2, Township 9 South, Range 58 East M.P.M.

Bentonite is a montmorillnite (2:1) clay and is generally mined in a hop-scotch pattern with a relatively large number of pits being open at any one time. Bentonite pits are small, 3 to 10 acres in size and as a rule are not over 50 feet deep. Bentonite mined by American Colloid near Alzada would generally be used for drilling mud, for foundry uses, and as a sealant.

This EIS is being distributed for public and agency review in compliance with Section 69-6504(b)(3) of the Montana Environmental Policy Act. All comments should be submitted to the Environmental Coordinator, Department of State Lands, Capitol Station, Helena, Montana 59601 by December 18, 1976.

All materials submitted to the Department by American Colloid Company for a contract pursuant to the Open Cut Mining Act (Title 50, Chapter 15, R.C.M. 1947) are on file and available for public review in the Department's Helena office.

Sincerely,

Dennis Hemmer
Research Specialist

DH/llw

Attachment

PLEASE RETURN

DRAFT ENVIRONMENTAL IMPACT STATEMENT
PROPOSED OPEN CUT MINING CONTRACT
FOR
AMERICAN COLLOID COMPANY

MONTANA DEPARTMENT OF STATE LANDS

November 12, 1976

Submitted pursuant to
Montana Environmental Policy Act
Section 69-6504(b)(3)

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I. INTRODUCTION

On August 5, 1976, American Colloid Company (ACCo) of Skokie, Illinois applied to the Montana Department of State Lands (DSL) to contract two sections of land in Carter County, Montana (Figure 1) for bentonite mining. The application is under the legal jurisdiction of the Open Cut Mining Act, Chapter 15, Title 50, R.C.M. 1947. This EIS is written persuant to the Montana Environmental Policy Act (Section 69-6403(b)(3) R.C.M. 1947. The location of the permit area is sections 1 and 2, Township 9 South, Range 58 East M.P.M., (Figures 1 and 2).

Bentonite is a Montmorillnite (2:1) clay. There are two types of commercial bentonite, calcium or nonswelling bentonite and sodium or swelling or Wyoming bentonite. Calcium or nonswelling bentonite describes a bentonite in which the cation exchange sites of the clay particles is dominated by calcium. Wyoming (sodium or swelling) bentonite is that in which the exchange sites are dominated by sodium. Sodium has a strong affinity for water; by drawing water into the clay lattice, the bentonite achieves its swelling properties. Wyoming bentonite can absorb up to 15 times its volume of water, resulting in a volume 15 times the original. Major uses of Wyoming bentonite are for oil well drilling mud, foundry moldings, as a sealant, and for binding taconite ore. Ninety to ninety five per cent of the world's commercially mineable deposits of Wyoming bentonite occur in South Dakota, Wyoming, and Montana (Robert Baker, ACCo Pers. Com.). Bentonite mined in the Alzada area is Wyoming bentonite.

Bentonite has a myriad of uses, from well drilling mud to a clarifier for wine. The Belle Fourche Daily Post (South Dakota) (1972) referred to bentonite as "The clay of 1000 uses." Each use of bentonite has a different set of quality specifications, with the highest quality generally required for oil well drilling

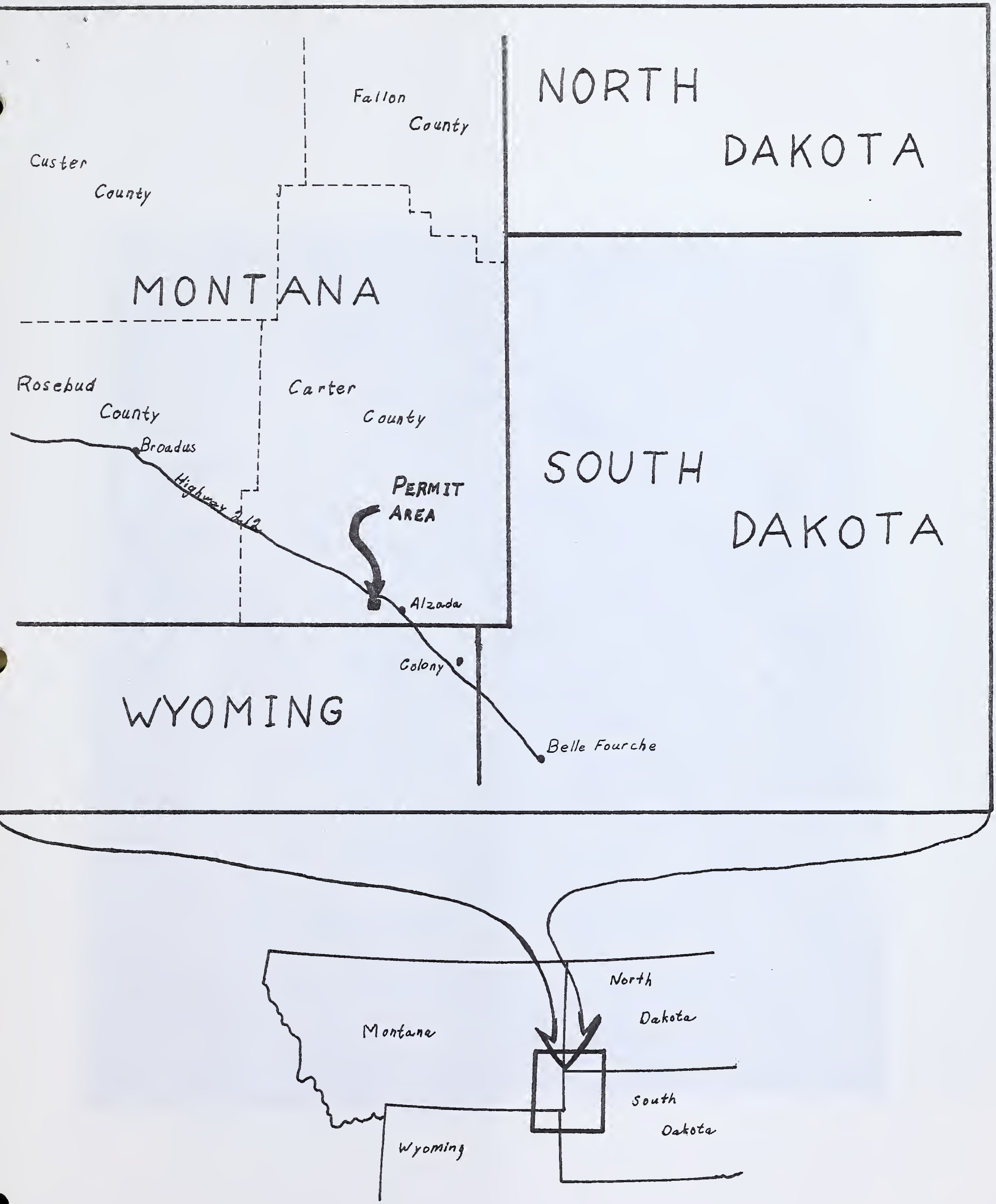


FIGURE 1

11/5/76 JRB

PERMIT AREA

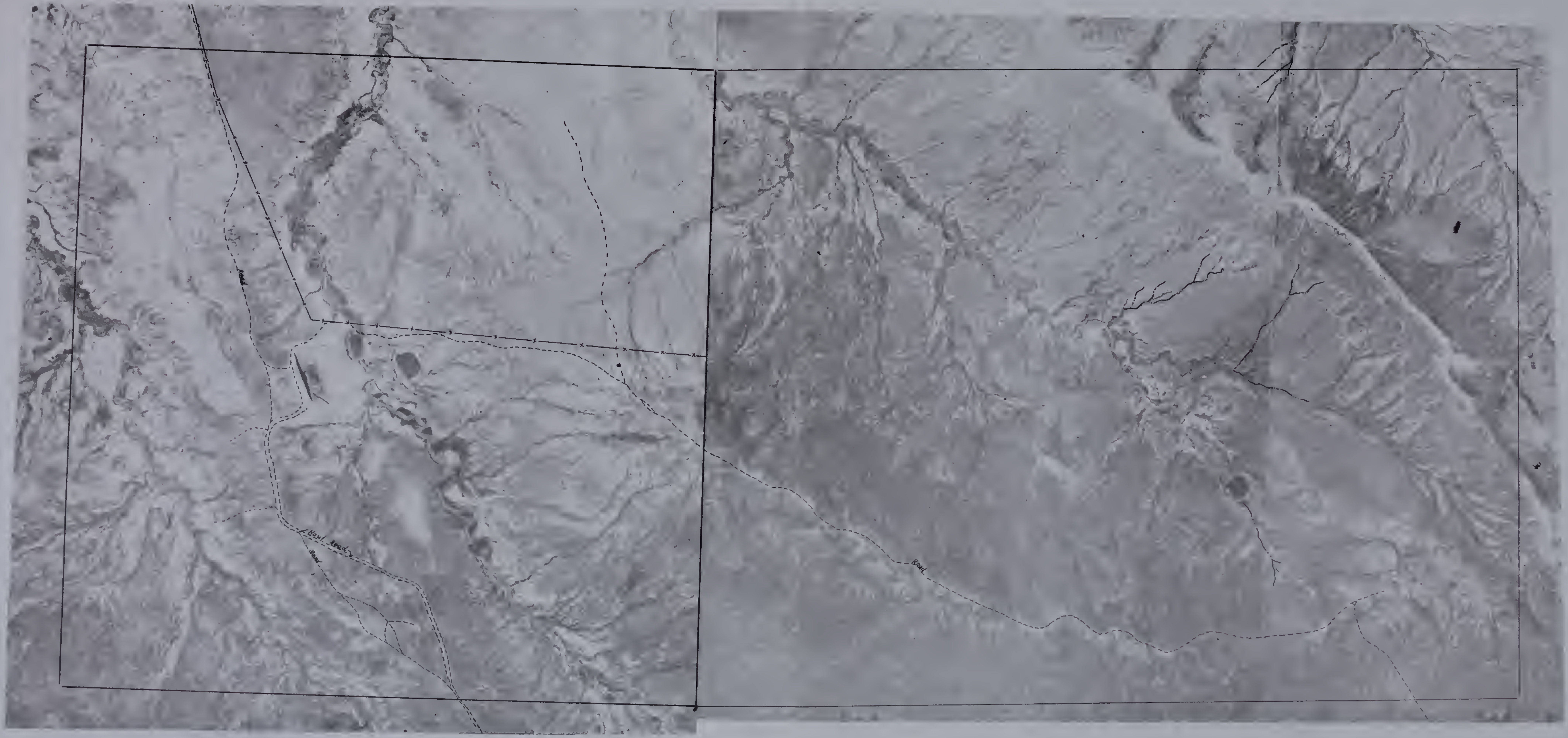


FIGURE 2

mud. Generally grade varies with the beds, and to some extent location within the bed. The general mining procedure is to drill an area to determine the extent, depth, and grade of a bed prior to mining.

A Bentonite mining company usually has contracts to supply bentonite for various uses, requiring different grades. Thus the company must have on hand all of these grades at one time. This requires the opening of different pits at different locations on a bed and possibly on different beds. The result is a hopscotch type mining with a relatively large number of pits being open at any one time.

The depth to which a company will mine bentonite depends on the grade and the thickness of the bed. A rule of thumb is that the stripping ratio will not exceed 10:1. That is ten feet of overburden will be removed for each foot of bentonite in the bed. The result is that normally pits are not over fifty feet deep. As a rule pits are small 3 to 10 acres in size. Where possible, pits are opened in sequence along a bed in a cut and fill type of operation. Variations in bed thickness and overburden depth results in pits or pit clusters often being placed rather haphazardly on a claim. Actual disturbance within a claim area is often quite small, with pits being located where the bed is thick enough or shallow enough to be economical to mine.

Bentonite mined by American Colloid at Alzada would generally be used for drilling mud, for foundry uses, and as a sealant.

II. LEGAL CONCERNS

The Montana Open Cut Mining Act (Section 50-1501 to 50-1516) applies to any mine operator intending to remove by surface mining 10,000 or more cubic yards of bentonite, clay, scoria, phosphate rock, sand, or gravel. The law requires

mine operators to enter into a contract with the state providing for the reclamation of mined land. A bond of $200 to $1000 per acre must be filed with DSL. A contract may be enforced by DSL through forfeiture of bond or criminal penalties. DSL has implemented rules pursuant to the Open Cut Mining Act.

The Montana Environmental Policy Act (MEPA) requires that Environmental Impact Statements (EIS) be prepared on proposals for projects, programs, legislation, and other major actions of state government significantly affecting the quality of the human environment (Section 69-6504). Pursuant to MEPA, the Department determined that contracting American Colloids proposed bentonite operations in Carter County was major and significant and hence requires that a draft EIS be prepared on the proposed action. DSL has implemented rules pursuant to MEPA.

III. MINING HISTORY IN THE BELLE FOURCHE (SOUTH DAKOTA) AREA

According to the Belle Fourche Daily Post (1972) the first claims were filed on bentonite in the Belle Fourche area in 1923, with the first processing plant beginning operation in 1934. By 1945 there were four plants mining and processing bentonite in the Belle Fourche area. Presently four companies are mining and processing bentonite in the general area, American Colloid Company with a plant in Belle Fourche, South Dakota, Baroid Division of NL Industries, International Minerals and Chemical Company (IMC), and Federal Bentonite Company all with plants in Colony, Wyoming. Mining has followed the bentonite deposits, starting near Belle Fourche and progressing through northeastern Wyoming and into Montana (Figure 1). The first company to begin mining in Montana was the Baroid division of NL Industries in 1968. Presently both Baroid and IMC are mining in Montana. Future estimates indicate that the three companies (Baroid, IMC, and ACCo) may wish to disturb up to 20,000 acres in Carter County.

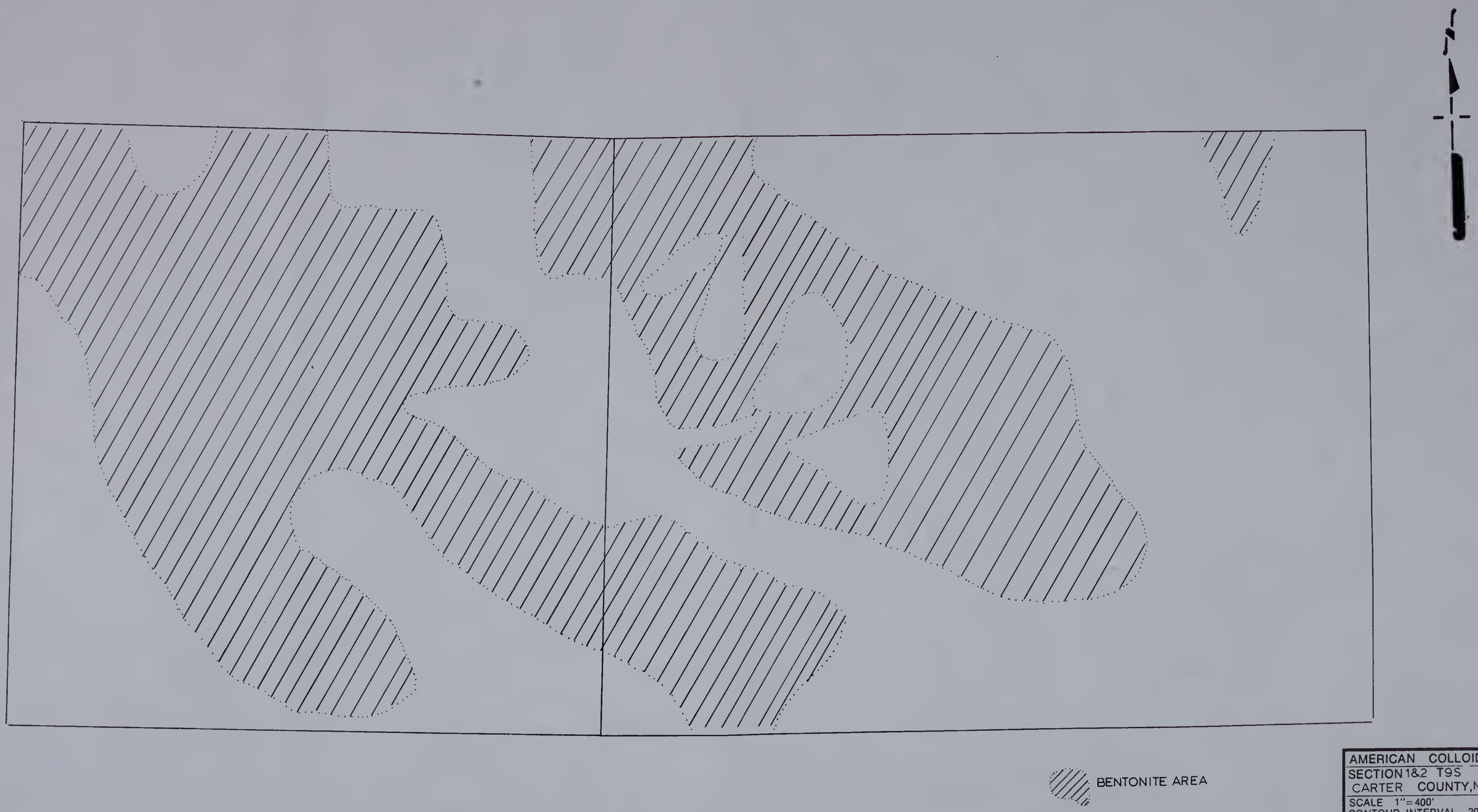
IV. MINING PLAN

Figure 4 represents the mining plan as submitted in ACCo's application for an Open Cut contract. Figure 3 shows the mineable bentonite. The proposed contract area would be mined by making three roughly continous strips of cut and fills. In addition one isolated mining area is proposed in the application (Figure 4). To what extent the strips would be continuous is unknown at this time. Changes such as in the grade of bentonite, depth of overburden, thickness of the seam, or market conditions may result in modifications to the mining plan. Any modifications in the mining plan must be approved by the Department of State Lands.

The following is the sequence to be followed in removing and replacing the topsoil, subsoil and overburden (ACCo 1976).

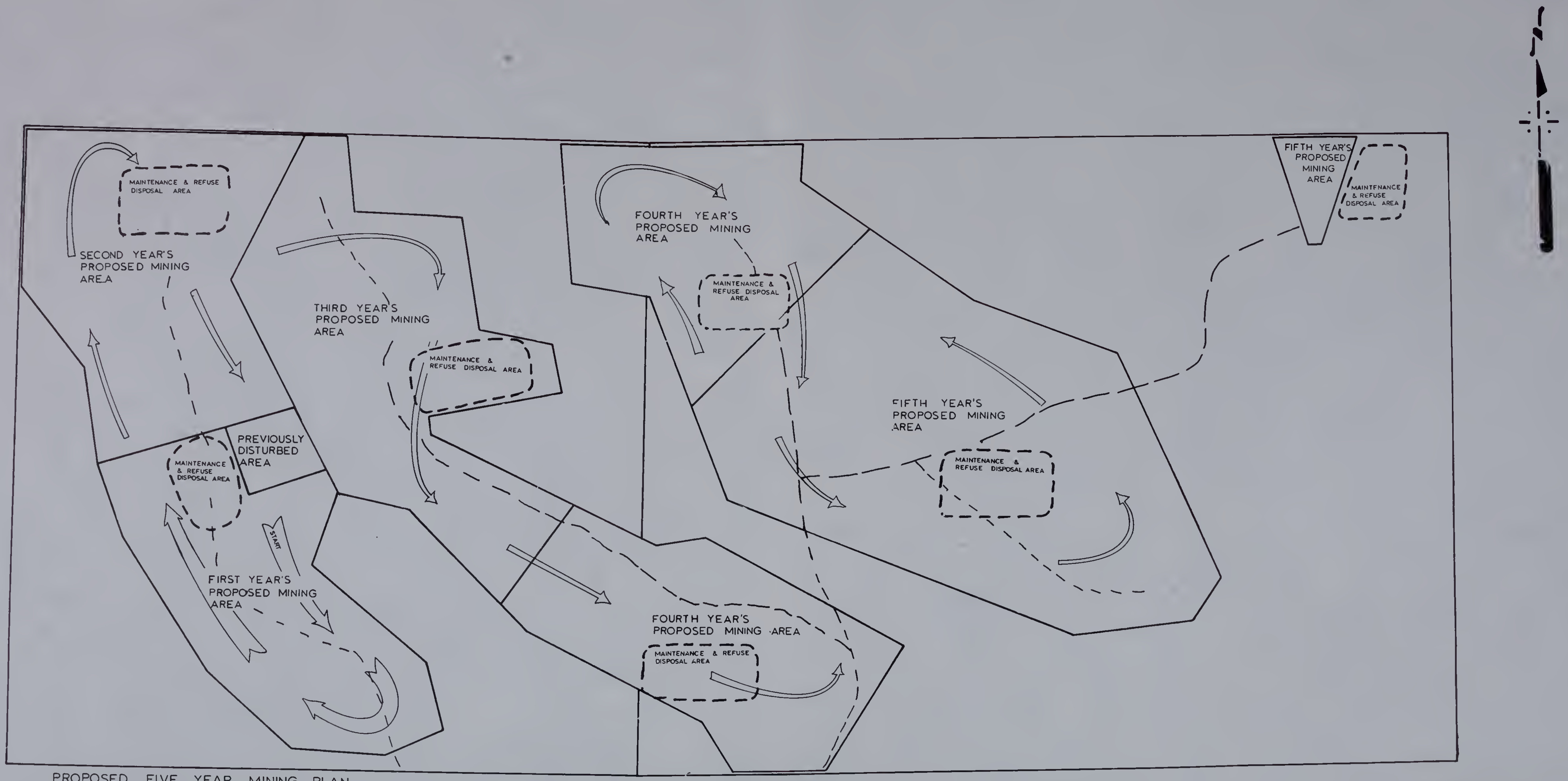
1) The existing topsoil is removed and stockpiled from the first pit and overburden area.
2) The subsoil is then removed and stockpiled from the first pit and overburden area.
3) The overburden is removed and piled and the bentonite is removed.
4) The topsoil from the next pit area is removed and stockpiled.
5) The subsoil from the next pit area is removed and spread on the first overburden area.
6) The overburden is removed and placed in the first pit area and the bentonite from the second pit is removed.
7) The topsoil from the third pit area is then spread on the previously spread subsoil on the first overburden area and the subsoil is spread on the first pit area.
8) This sequence continues throughout the area to be mined until the last pit is encountered at which time the subsoil and then the topsoil from the first pit are spread on the last cut.

This sequence is illustrated in Appendix A.



AMERICAN COLLOID CO.
SECTION 1&2 T9S R58E
CARTER COUNTY, MONT.
SCALE 1"=400'
CONTOUR INTERVAL 20'
DRAWN BY ___ CHECKED BY ___
DATE ___________

FIGURE 3


MAINTENANCE & REFUSE DISPOSAL AREA
SECOND YEAR'S PROPOSED MINING AREA
THIRD YEAR'S PROPOSED MINING AREA
MAINTENANCE & REFUSE DISPOSAL AREA
PREVIOUSLY DISTURBED AREA
MAINTENANCE & REFUSE DISPOSAL AREA
START
FIRST YEAR'S PROPOSED MINING AREA
FOURTH YEAR'S PROPOSED MINING AREA
MAINTENANCE & REFUSE DISPOSAL AREA
FOURTH YEAR'S PROPOSED MINING AREA
MAINTENANCE & REFUSE DISPOSAL AREA
FIFTH YEAR'S PROPOSED MINING AREA
MAINTENANCE & REFUSE DISPOSAL AREA
FIFTH YEAR'S PROPOSED MINING AREA
MAINTENANCE & REFUSE DISPOSAL AREA
N

PROPOSED FIVE YEAR MINING PLAN

NOTE: All shale or borrow pits will be located inside the proposed mining area.

PROPOSED LOCATION OF 45' WIDE HAUL ROAD — — —
DIRECTION OF MINING ⇨

AMERICAN COLLOID CO
SECTION 1,2 T9S R58E
CARTER COUNTY, MONT.
SCALE 1"=400'
CONTOUR INTERVAL 20'
DRAWN BY BB CHECKED BY J.L.
DATE Oct. 12, 1976

FIGURE 4

V. DESCRIPTION OF EXISTING ENVIRONMENT

A. Physical Environment

1. Topography

The area consists of gently rolling hills disected by mesic drainages. The permit area is a concave grassland with gentle slopes draining into Willow Creek (Figure 2). Elevation is approximately 3,450 feet.

2. Climate

The climate of the area is one of extremes. In 1975 the low temperature was -30° F. recorded in January, the high was 108° F. recorded in July. Precipitation is likewise erratic, ranging from a low of 7.80 inches recorded in 1952 to a high of 19.48 in 1962. Average annual rainfall for the last 30 years is 14.16 inches. Precipitation in this area, as in most of eastern Montana, is a boom and bust phenomenon with years of near average precipitation being the exception rather than the rule (Appendix B).

3. Air Quality

Air quality of the proposed mining area is generally near pristine, with the only sizable source of degradation being dust from non-point agricultural and transport (gravel haul roads) sources. In the future air quality degradation may result from large coal fired generating plants in eastern Montana.

4. Geology

Bentonite deposits of southeastern Montana occur in the Northern Black Hills bentonite mining district, which includes parts of Crook County, WY, Butte County, SD, and Carter County, MT (Knechtel and Patterson, 1962). Bentonite occurs within this district at many stratigraphic horizons in rocks of Mesozoic and Cenozoic age, but it has been mined only in units of Cretaceous (late Mesozoic) age.

The Cretaceous formations were deposited under marine conditions and comprise mainly shale, marl, and argillaceous sandstone. Bentonite production has been mainly from the Mowry (lower Cretaceous) and Belle Fourche (upper cretaceous) formations. The Mowry is about 20' -250' thick and consists of siliceous shale interbedded with silty mudstone and brightly colored bentonite. It is separated from the overlying Belle Fourche by the Clay Spur bentonite bed, although in many places this bed is overlain by a layer of shale, typical of the Mowry.

The proposed American Colloid Mine would operate in bentonite units of the Belle Fourche formation. The Belle Fourche comprises an upper and a lower member. The lower ranges between 425 and 540' in thickness and consists of dark shale, sandy shale, and gray sandstone, with many bentonite beds, especially near the top. The upper member (25' -285') consists almost entirely of dark-gray shale with some bentonite beds.

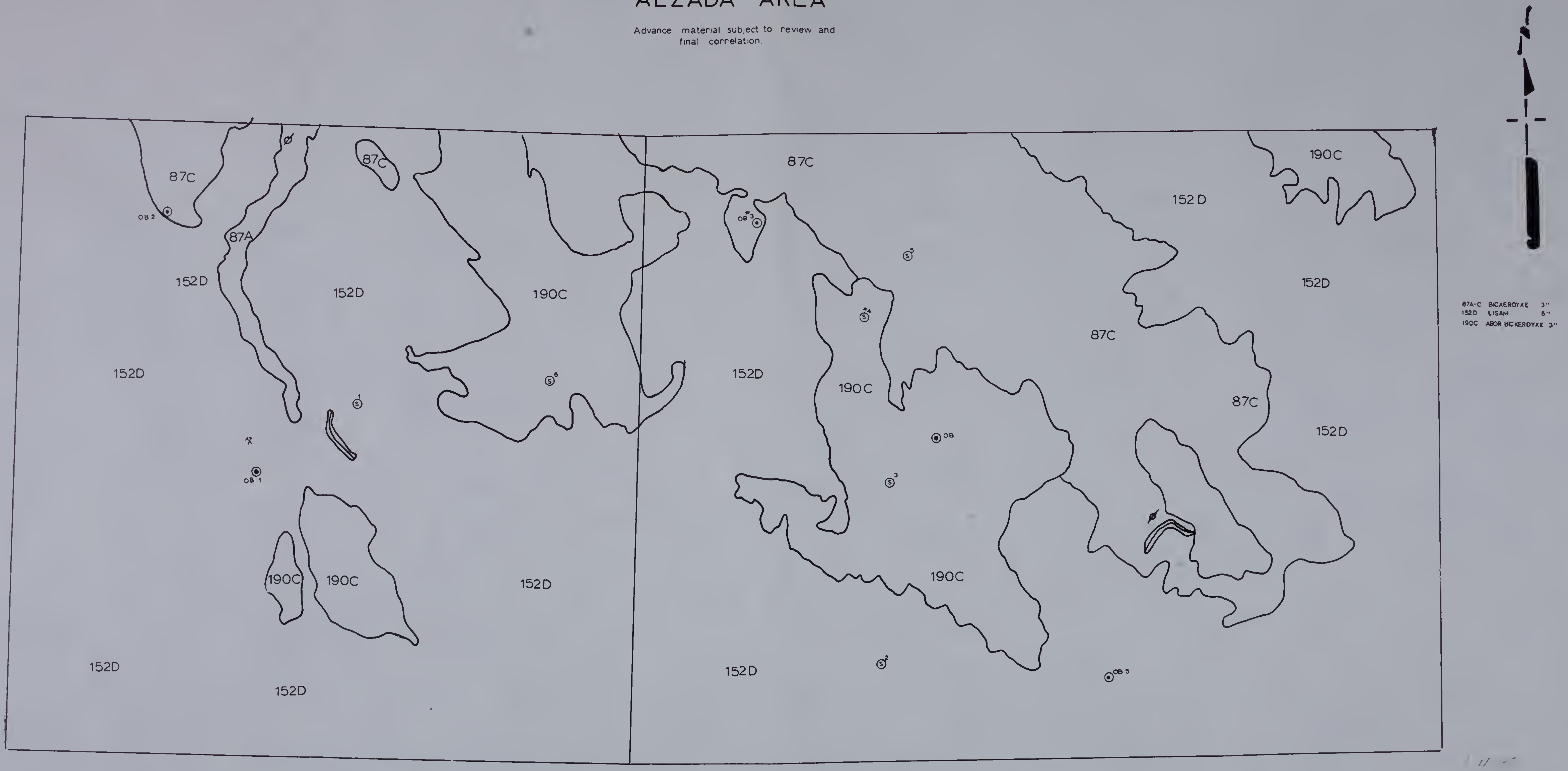
5. Soils and Overburden

The soils in the area affected were mapped by SCS personnel and are composed of three mapping units (Figure 5) made up of three soil series - the Abor, Bickerdyke, and Lisam series. Profile descriptions, and classification of these soils are included in ACCo's application for an Open Cut contract. Subsequent discussion with the SCS has revealed that the Abor series will be renamed Bascovy (Mike Jackson, SCS Personal Communication). However, the basic classification of this soil will remain unchanged.

These soils were formed from shales either in place or after reworking or movement. The Bascovy (Abor) and Bickerdyke soils are aridisols (soils of arid regions) which are characterized by limited weathering and leaching. Thus the morphology of aridisols (substantially reflects the nature of the parent material

SOIL DATA
ALZADA AREA

Advance material subject to review and
final correlation.



87A-C	BICKERDYKE	3"
152D	LISAM	6"
190C	ABOR BICKERDYKE	3"

LEGEND
OB ○ OVERBURDEN TEST SITES
Ⓢ TOP SOIL SAMPLE SITES

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CARTER COUNTY, MONT.
SCALE 1"=400'
CONTOUR INTERVAL 20'
DRAWN BY ___ CHECKED BY ___
DATE ___________

FIGURE 5

(Buol, et. al., 1973). The Lisam soil is an entisol which is a soil of very limited development due to factors such as a dry climate or brief period of time that has elapsed since parent material has been exposed to weathering, (Buol, et. al., 1973). All of these soils were given a field textural designation of clay. They all have very low permeabilities limiting water movement and aeration and have high shrink-swell potentials.

The profiles of these soils were sampled and sent to the South Dakota School of Mines for analysis. The results are provided in ACCo's application for an Open Cut contract. DSL insists upon a minimum of samples for each soil phase. The Lisam series exhibited large variations in SAR (sodium absorption ratio) and EC (electrical conductivity). Thus DSL asked for additional sampling of this series, the results of which have also been made part of ACCo's application for an Open Cut contract. These analyses indicate that these soils tend to be strongly saline (EC greater than 10 mmhos) and fairly sodic (SAR greater than 10), although both of these adverse conditions occurred much less frequently in the top 6" of soil. The Lisam series exhibited only infrequent sodic conditions throughout the profile. Quantitative analysis of particle size distribution confirmed the exceedingly fine-textured nature of the soils. However, analyses were not done entirely in accordance with DSL guidelines since the silt and clay fractions were not reported as separate entities.

Water-soluble boron contents exceeded DSL's current red flag levels (8 ppm) in two cases - in the 0-6" layers in one Lisam profile at 11 ppm and one Bascovy (Abor) profile at 9 ppm. Other samples, although below current DSL red flag levels, were still moderately high.

A curious feature of the Lisam soils involved pH's that were as low as 2.9 which appears incongruous relative to the high soluble sodium contents in some samples. One possible explanation stems from the observed occurrence of sulfur

"nodules" in one Lisam profile which might result in acid conditions if enough of this sulfur has been oxidized over time. An alternative but less likely explanation concerns the possible interference of the response of the glass pH electrode used in the actual measurement by some unknown ionic or chemical species. Assuming these low-soil pH's are accurate, phosphorus availability would probably be unfavorable due to the formation of insoluble iron, aluminum, and manganese phosphates under such acid conditions (Buckman and Brady, 1969).

Final the ratios of soluble calcium to magnesium in C horizon material (and sometimes B horizon) tends to be quite low i.e. less than 1:1. This can have adverse affects on the calcium nutrition of certain sensitive species such as clovers (Power, et. al., 1975).

In summary, then, these soils are weakly developed, have thin "A" horizons, are quite saline and often sodic below 6", and have clay textures. They thus provide a stressful substratum for the rooting of plants and for general biological activity. Nevertheless, a substantial amelioration of the saline and sodic conditions in the top 6" of several profiles is evident. This is probably due to leaching. Furthermore, in the A horizon resides the maximum accumulation of organic matter which is the wellspring of soil fertility. Thus present biological productivity is probably highly dependent on these surface horizons.

A final feature of these soils, to which existing plant communities may have adjusted and developed accordingly, is the indicated occurrence of chemical and physical gradients and microhabitats in the soil profiles. Changes in: salinity, water soluble boron contents, and calcium magnesium ratios down the profiles are examples of such gradients and may be suggestive of other vertical changes of important chemical and physical constituents. In addition, cracks observed in Bascovy and Lisam soils and substratum and the tubular pores noted in many horizons may be manifestations of significant biological microenvironments.

Roots were observed growing down as far as five feet in some of these cracks. These cracks and pores may also serve as critical avenues of water and gas exchange for the activity of deep-lying roots and associated micro-organisms. Finally surface infiltration of water would be promoted by such fissures and potential surface erosion accordingly reduced.

Five overburden holes were drilled at ACCo's proposed mine site and samples taken for analysis from a 2' interval every 6' -7' throughout the length of the drill hole. This procedure is not in accordance with DSL guidelines which requires sampling of all strata down to the bentonite. Examination of the data suggested that additional sampling below the top 6' would be of little value. However, additional sampling above 6' was requested and this was incorporated into the further soil sampling initiated on the Lisam series. All samples were analyzed by the South Dakota School of Mines and the resultant may be found in ACCo's application for an Open Cut Mine contract.

The overburden is exceedingly fine-textured, highly saline (EC 8 mmhos) and, below 17 feet, fairly sodic (SAR 10). Again the particle size analysis was not done in accordance with DSL guidelines as discussed above for soils. Thus it is not known precisely what the individual per cents of silt and clay are.

Although the predominance of clay seems evident, the overburden was also characterized by moderately high concentrations of DTPA-extractable nickel (3-4 ppm). DSL considers 1 ppm as a "red flag" level with respect to potential phytotoxicity. However, other overburden characteristics may modify the actual interpretation of the existence of or degree of hazard. In this case, the upper and middle strata were also characterized by substantial DTPA-extractable iron concentrations; iron is known to reduce the phytotoxicity of nickel (Lisk, 1972).

However, the lower strata may still be of some concern since their iron contents are considerably lower, but their nickel contents are fairly high; furthermore, in the normal course of mining and backfilling, these materials will end up at the surface. Problem concentrations of other trace metals were not evident, although water-soluble boron concentrations tended to be moderately high in most samples. In only one case did the boron content exceed the current DSL red flag level of 8 ppm. That occurred at the 42-44 foot level of hole #5 where the water-soluble boron content was 9 ppm.

6. Hydrology

Surface water flow in the proposed contract area is minimal. Observable surface water flow in drainageways is largely confined to periods of snow melt when soils are saturated or periods of high rainfall associated with thunderstorm activity. The major drainages (Figure 2) in the proposed contract area can be described as intermittent.

Behavior of ground water in the proposed contract area is effected largely by the existence of the bentonite bed itself. Water percolating down from the surface encounters the bentonite bed which acts as an aquiclude. The amount of ground water present above the bentonite bed can best be described as insignificant. Sufficient quantities probably exist to insure that stock water ponds created by excavations will be supplied with water for at least most of the year; this is evidenced by the existence of upland marsh within the proposed contract area.

Information on the existence of ground water below the bentonite bed is scant. However, south of Alzada bentonite mining on at least one occasion intercepted ground water below the bentonite bed. Ground water encountered by the excavation occurred in a aquifer capable of producing a flowing spring. Such a aquifer may exist under portions of the proposed contract area.

B. Biological Environment

1. Vegetation

The permit area is generally a rolling grassland. Ecological Consulting Service (ECS) 1975b in describing the vegetation of the general area, classified most of the permit area (1,463 acres) as Big Sagebrush - Grassland (Figure 6). In this community type the common grasses were western wheatgrass (*Agropyron smithii*), blue grama (*Bouteloua gracilis*), prairie junegrass (*Koeleria cristata*), and needle-and-thread grass (*Stipa comata*). Big sagebrush (*Artemisia tridentata*) was the most common shrub, with broom snakeweed (*Guterrezia sarothrae*), snowberry (*Symphoricarpos spp*) and prairie rose (*Rosa arkansana*) also present.

Ten (10) acres in the proposed contracted area were described as Upland Marsh, a type confined to stock ponds and mesic drainage ways. Common grasses in this community type include alkali cordgrass (*Spartina gracilis*), alkali muhly (*Muhlenbergia asperifolia*), inland saltgrass (*Distichlis stricta*), and little bluestem (*Andropogon scoparius*). Summer cypress (*Kochia scoparia*) was a common forb.

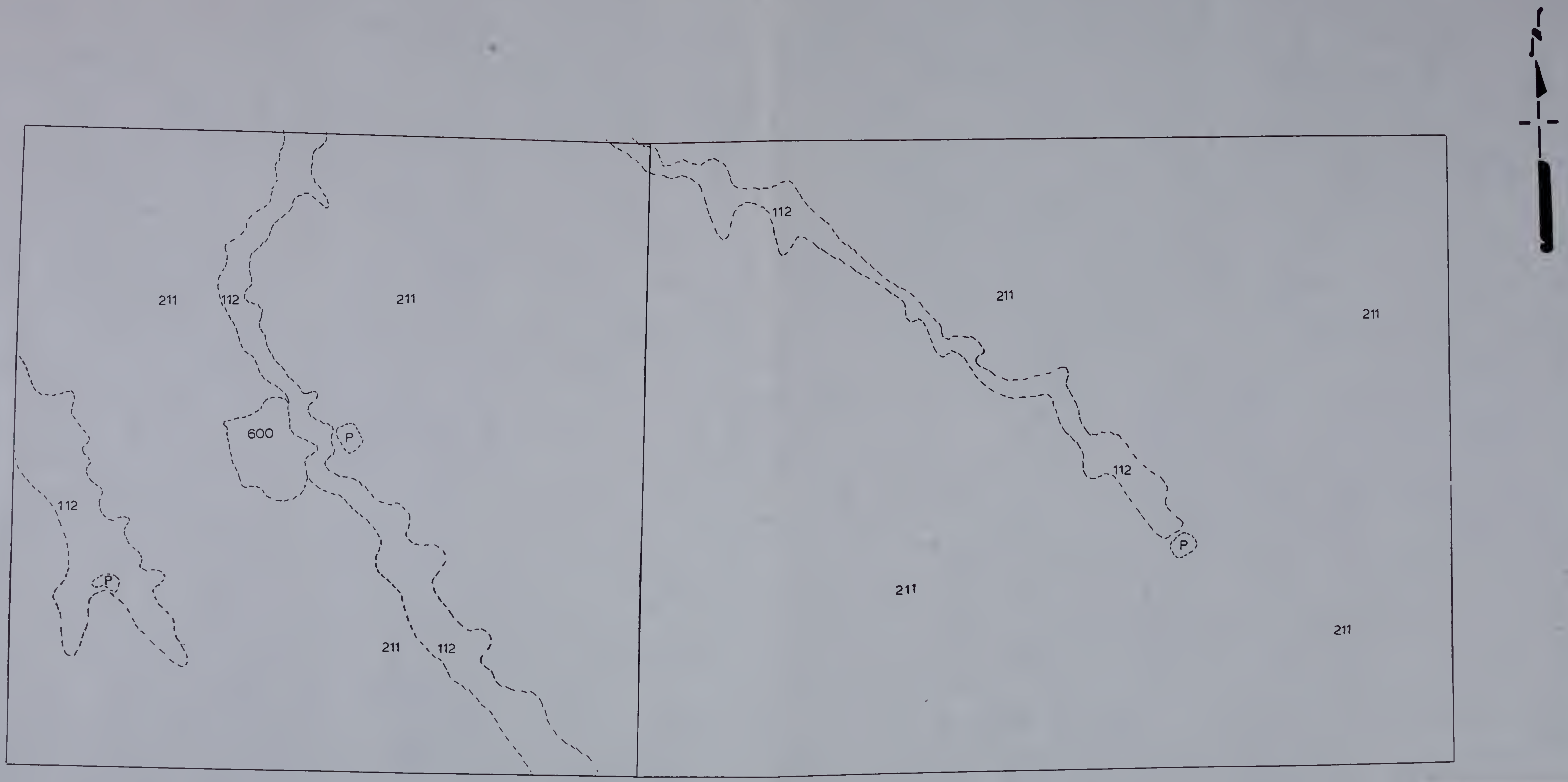
Four (4) acres were classified as stock ponds, and eight (8) acres as previously disturbed by a bentonite test pit. This test pit has been reseeded and presently has a sparse cover composed of western wheatgrass, green needlegrass (*Stipa vividula*), yellow sweet clover (*Melilotus officianalus*), and oats (*Avena sativa*).

This vegetation work was done previous to implementation of present DSL vegetation guidelines and as such was not required to comply with them. Subsequent inspection by DSL found that the study did not comply with present guidelines.

A list of vegetation species identified in the Alzada Area is given in Appendix C.

2. Wildlife

Antelope (*Antilocapra americana*) and Mule deer (*Oclocoileus hemionus*) were the only animals actually observed on the permit area (E.C.S. 1975b). The permit



VEGATATIVE MAP

LEGEND

112	UPLAND MARSH
211	BIG SAGEBRUSH GRASSLAND
600	MINING AREA
P	STOCK POND

AMERICAN COLLOID CO.
SECTION 1&2 T9S R58E
CARTER COUNTY, MONT.
SCALE 1"=400'
CONTOUR INTERVAL 20'
DRAWN BY ___ CHECKED BY ___
DATE ___________

FIGURE 6

area also contains suitable habitat for sage grouse (Centrocercus urophasianus) and sage grouse probably are present at some point during the year.

Antelope are the most common big game species in vicinity and the contract area represents optimum antelope habitat ("rolling open grasslands with large areas of sagebrush, primarily big sagebrush") (ECS 1975a). On a visit to the proposed contract area on July 15, 1976, six groups of antelope were seen ranging in size from a lone buck to a group of five, were seen (approximately 14 total).

According to ECS (1975b) Mule deer utilize the sagebrush - grassland habitat type during the spring. Fawn:doe ratios of 66:100 and 130:100 were calculated for October of 1974 and 1975 respectively. According to the productivity rating of Eustace (1971) these productivities rate as fair and excellent respectively. One mule deer sighting was reported for the area to be permitted (ECS 1975a).

White-tailed deer (Odocoileus virginianus), sharptailed grouse (Pediocetes phasianellus), Merriam's Turkey (Meleagris gallopavo merriami), Chinese pheasant (Phasianus colchicus), and Hungarian partridge (Perdix perdix) are also reported as present in the general area but were not reported on the proposed contract area (ECS 1975a). No habitat suitable for these species exists on the proposed contract area.

Waterfowl were reported to be abundant in the local area, but were not reported as present on the proposed contract area (ECS 1975a). Two ponds of approximately two acres each are found on the permit area, in addition to a pond formed by the test pit. These ponds are undoubtedly used by waterfowl during some portion of the year.

Red fox (Vulpes vulpes), and bobcats (Lynx rufus), were present in the general area, however considering the habitat, bobcats probably do not utilize the permit area.

Several raptors were also reported in the general area including golden eagle (Aquila chrysaetos), rough-legged hawk (Buteo lagopus), red-tailed hawks (Buteo jamaicensis), marsh hawks (Circus cyaneus), and kestrels (Falco sparoevius). Each of these raptors probably utilize the proposed contract area as well.

Numerous small mammals were reported in the general area and are listed in Appendix 2. Of these white-tailed jackrabbits (Lepus townsendii), mountain cottontails (Sylvilagus nuttalli), skunks (Mephitis mephitis), coyote (Canis latrans), western deer mouse (Pevomyscus mariculatus), and the western harvest mouse (Reithrodontomys megalotis) are probably found on the permit area.

A list of mamalian species identified in the Alzada area is given in Appendix C.

Birds seen in the general area are reported in Appendix C. Of these all of those suited to a shrub - grassland or pond type habitat are probably found on the proposed contract area.

C. Human Environment

1. Demographics

The permanent population of the Alzada area is relatively stable. In recent years there has been an increasing number of people transient to Alzada employed exploration companies drilling for uranium. The town of Alzada consists of two bar-cafe combinations, one service station-garage, one service station-grocery store, one motel, and 10-15 residences. The total population of the Alzada Area is unknown; the population of Carter County in 1975 was estimated to be 1,990 (Montana Department Community Affairs, 1975). The Carter County seat is Ekalaka with a population of 663 (1970 Census, DCA 1975).

2. Land Use

Rangeland is the most common land use in the Alzada area (61%, DCA 1975). Hay fields, both wild and cultivated, small grains, and bentonite mining operations occupy lesser acerages. Land occupied by urban areas is negligable, with Alzada being the only town in the area. Average farm size in Carter County was 4,135 acres in 1969 (DCA 1975).

3. Local Economy

The Alzada economy is dependent almost entirely on ranching. A few people are employed by local bentonite companies, primarily by contract haulers. Those persons employed by exploration companies often stay in the Alzada Motel and patronize the local bar-cafes.

Median family income for Carter County in 1969 was $8,595.00 (DCA 1975); fourteen percent of Carter County families in 1969 had median incomes below the poverty level (DCA 1975).

4. Social Structure

The Alzada area social structure is ranch type-agrarian.

5. Social Services

Alzada is an unincorporated community. The only services furnished are local fire control.

Carter County (3,313 sq. miles) has one weekly newspaper, one bank, one hospital, two schools, (elementary and high school) and no libraries.

6. Archeological - Historical

The proposed contract area was not suited for aboriginal occupation. The area was utilized occasionally as a hunting area, with camp sites found along some of the permanent drainages (ACCo, 1976).

7. Transportation

Alzada is bisected by highway 212 which connects it with Belle Fourche, South Dakota and Broadus, Montana (Figure 1). Highway 212 is in relatively good shape at the present time.

8. Taxes

ACCo presently pays no taxes on its Alzada holdings (Bob Baker, ACCo, Pers. Com).

9. Agricultural Production

The proposed contract area presently supports approximately 445 A.U.M.s of grazing. Range condition is fair.

VI. ENVIRONMENTAL IMPACTS OF THE PROPOSALS

A. Physical Environment

1. Topography

Bentonite mining would modify the topography of the area in that for the first cut and for isolated pits, a mound would be permanently left. Likewise for the final cut and for isolated pits a pond would be left.

2. Climate

Climatalogical impacts should be restricted to microclimate changes as a result of the removal of vegetation, slight topographic changes, and the presence of different colored stratum on the surface. Such impacts are expected to be minimal.

3. Air Quality

Air quality will be degraded by two sources, dust from mining and hauling, and diesel exhaust from mining and hauling. Diesel exhaust will likely do little damage to the overall quality of the air. Dust from mining will likewise

be negligible as many of the strata mined will be wet and little dust will be generated. The main source of air quality degradation will be from hauling, both from dust generated by the haul wagons and dust raised by wind blowing across the haul road. Montana will be less impacted than the two adjacent states as there will only be approximately 9 miles of haul road in Montana. There will be approximately a 40 mile haul through Wyoming and South Dakota. There may also be some dust from stockpiled topsoil and overburden.

4. Soils and Overburden

The soil profiles, vertical gradients of chemical constituents existing therein, and cracks and pores all of which may be of importance to some existing plant communities would be destroyed by mining and cannot be artificially recreated. There may be some reestablishment of such features as a natural part of soil and plant community development, although long periods of time would be involved due to the arid nature of the climatic regime. The only feature that may form in substantially shorter periods of time are cracks that form as a response to shrinking and swelling of clays due to wetting and drying cycles.

ACCo's reclamation plan specifies the separate salvage of surface soil and subsoil for subsequent redistribution. This is a desirable approach since the best soil material occurs in the top several inches and as much buffering capacity as possible will be needed against the more undesirable subsoil and spoils material. This also offers the added advantage of a source of native plant seed and other propogules for future revegetation. ACCo has proposed stripping off the 0-6" layer of Lisam and the 0-3" layer of Bascovy and Bickerdyke for use as topsoil. Subsoil stripping depths vary from 18-60" in the reclamation plan. It would be wise to increase the topsoil stripping depths of the last two soil series to 6" in order to incorporate as much of the

best soil material as possible into the topsoil. In spite of these considerations, the adequacy of this much topsoil for reclamation purposes has yet to be determined in view of the adverse features of topsoil discussed previously (salinity, Ca/Mg ratios, etc.).

A quick vegetative cover on regraded and retopsoiled spoils appears crucial because the swelling nature of these clay soils and subsoils and the high SAR values of subsoils (indicating potential tendencies for dispersal) render this material increasingly subject to water erosion. This assumes greater importance in view of the shallow depths of desirable topsoils that are available and the significant impacts of any loss of such topsoils on reclamation. The undesirable SAR values of subsoils may be mitigated to some extent by mixing of this material during stripping which will more evenly distribute gypsum crystals occurring there throughout this material (Power, et. al., 1975). However, this would not mitigate the saline nature of this material and may even enhance it.

Backfilling and grading appears to generally follow the plan of utilizing overburden and soils material taken from one pit to backfill previously mined out pits. This would be advantageous from the standpoint that stockpiling of soils material would apparently be avoided as much as possible which would minimize handling and compaction.

A problem whose potential occurrence and extent are quite difficult to predict is salinization of soil material due to redistribution of salts after regrading and retopsoiling. This phenomenon would depend on new relationships established among soils, spoils, topography, plants, and water regimes. This consideration becomes exceedingly important in view of the paucity of "suitable" topsoil. The only treatment that could systematically be utilized in an attempt to prevent upward movement of salts would be to rip the overburden surface after regrading and to disc or loosen up the subsoil surface after laying down

this material. This would help to prevent the formation of a perched water table close to the soil surface which might otherwise result in increased salinization of soils material (Doering 1975).

Ripping of the overburden surface would also help to provide a non-slip surface for the soils material to rest on. Light discing of topsoil before seeding would benefit the seedbed by providing a looser, more non-compated substratum.

The lower strata in the overburden that was of some concern due to their nickel concentrations will meet the burial requirements of the law in that the subsoils and topsoil will provide at least two feet of material to be placed over these spoils.

5. Hydrology

Impacts to the hydrologic system should be minimal. Where pits are located in watercourses, ponds will of course occur. If ponds have been excavated below the water table, water levels will be maintained by water available from the aquifer.

Mining operation may necessitate the diversion of drainages around exposed bentonite seams. This diversion will cause no significant effects to the system.

The only significant impacts to the system will be the storage of otherwise "lost" surface water in ponds, and the interception of the water table creating a pond.

B. Biological Environment

1. Vegetation

Damage to vegetation will range from relatively minor trampling by vehicles to total destruction by mining. Such damage would occur during both the premining

and mining periods. Vegetation compressed by drill trucks and other vehicles associated with premining activities would be little affected in all but wet periods. During wet periods such vehicles could cut deep ruts thus, killing vegetation. However, vehicle travel is nearly impossible at such times due to the nature of the area and thus such rutting should be minimal.

During mining periods, some trampling/compressing activity would also occur, ranging from minor impacts by pickups to serious destruction by scrapers, loaders, and possibly haul wagons. Such impact would be more serious were roads created.

Open pit mining results in total destruction of the vegetation in the pit area and under topsoil and overburden stockpiles.

Dust generated from hauling may impact vegetation over a wide area. Dust settling on plants has three potential detrimental impacts:

(1) Dust on leaf surfaces may cut down the photosynthetic ability of the plants. Also dust may plug the stomas of leaves, thus decreasing the plants transpirational and gaseous exchange ability. The impacts of dust on leaves may be especially important to seedlings.

(2) Airborne dust may screen light from the plants as airborne dust could have a fog-type effect. The magnitude of such impact would depend on the density of the dust. The closer to the source the greater the impact.

(3) Dust settling on leaf surfaces may also be detrimental to digestion of plants by herbivores.

Any modification of water courses could result in alterations of the upland marsh vegetation type. This may vary from a complete dieout of mesic species and alteration to more xeric species, to a decreased vigor of mesic species while the water is being diverted.

2. Wildlife

Wildlife in the area would be impacted by habitat destruction, and by the disruptions caused by increased human activity in the area. Destruction of

sagebrush in the sagebrush/grassland habitat would significantly affect mule deer, sage grouse, and antelope. Sage grouse in the permit area would be affected the most. Sage grouse rely on sagebrush for both cover and food the majority of the year. Antelope utilize sagebrush heavily during the winter, but being more mobile the impact would be less than that on sage grouse. Mule deer rely on the sagebrush/grassland for food at intervals during the year. The loss of this type through destruction of the vegetation would essentially lower the carrying capacity of the whole area, forcing the animals presently on the permit area onto less desirable areas, possibly resulting in their demise.

The greater access to the area afforded by haul roads would also impact wildlife. In addition to the disruption of activities resulting from mining activity, greater hunting pressure would be expected.

C. Human Environment

1. Demographics

There will be essentially no impact on the demographics of the area. All the people to be employed on the project are presently employed by the company.

2. Land use

Land use will change from range land to mining.

3. Local Ecomony

There will be little impact on the local economy. The only money generated locally will be that paid in royalties to the mineral lease holders.

4. Social Structure

Virtually no impacts are expected.

5. Social Services

Virtually no impacts are expected.

6. History/Archeology

There will be little impact archeologically. The area was used by aboriginal man only for intermittent hunting. The only possible artifact loss could be a small number of arrowheads or spear points (ACCo 1976).

7. Transportation

Little impact is expected. There may be some local use of haul roads. A slight (20-30 vehicles per week maximum) increase of traffic using U.S. 212 from Alzada to Belle Fourche will result from personnel traveling to and from the mining site. All hauling would be done on Private haul roads closed to the public.

8. Aesthetics

Aesthetics of the area would be impacted by bare mounds resulting from mining and from cuts and roadbeds created by construction of the haul road. Aesthetics are also impacted by the noise of mining and hauling.

9. Taxes

When mining commences two taxes will be accrued by Montana. Income tax would be paid by employees working in Montana and by the mineral rights holder on royalties. ACCo must also pay a Resource Indemnity Trust Tax.

The Resource Indemnity Trust Tax is computed at a rate of one half of one per cent the gross value of the mineral at the mine head (see Table 1). Five thousand dollars is deducted from the gross value. The operator pays tax on the gross value over $5,000 plus a $25.00 annual fee.

Table 1.--Resource indemnity tax schedule

1. Quantity of minerals, expressed in standard units of measurement, extracted or produced and treated or sold during calendar year covered by this report and the gross yield expressed in dollars and cents.

QUANTITY	KIND OF MINERAL	GROSS YIELD OR VALUE
	TOTAL	

2. Adjustments (if required). Provide complete explanation:

3. Gross value of mineral at the time of extraction or production (line 1 less than line 2) . . . . ________

4. Less value of minimum annual tax . . . . $ 5,000.00

5. Balance (line 3 and 4) . . . . ________

COMPUTATION OF TAX

6. ½ of 1% (.005) of the amount on line 5 . . . . ________

7. Annual tax . . . . $ 25.00

8. TOTAL TAX DUE (line 6 plus line 7) . . . . ________

Using a figure of 1,000,000 tons per year production (Robert Baker, ACCo Pers. Com.) and a mine head gross value of $.50 (Average royalty paid on bentonite, this should be a minimum value) ACCo would annually pay $2,500.

10. Agricultural Production

A maximum of 445 A.U.M. (Animal Unit Months) per year would possibly be lost during the course of mining.

11. Human Health

Dust and noise created by mining would possibly affect the human health in the area. The primary impacts of dust and noise would be to operators, but local residents may also be affected to a lesser degree.

VII. MITIGATING OR COMPENSATING MEASURES

A. Physical Environment

1. Topography

Impacts to topography would be minimized by attempting to keep ponds and

subsequent mounds to a minimum by cutting and backfilling wherever possible. ACCo has agreed to try to limit ponds to one per quarter section.

2. Air Quality

In an effort to control dust, ACCo has purchased a new water wagon with a capacity of 15,000 gallons. This water wagon can go 5 miles per fill for a rate of 3,000 gallons per mile. An additional impact will result from use of this new water wagon. The removal of water will lower the level of ponds impacting water fowl and emergant vegetation. If water from Thompson Creek is used, a water use permit would will have to be filed. Since water rights are previously filed on Thompson Creek, no water may be available most of the year.

3. Soils and Overburden

ACCo's proposed reclamation plan includes the discrete removal and salvage of topsoil and subsoil from each series by scrapers. This will result in destruction of existing soil-plant relationships and of the previously discussed chemical and physical gradients and microhabitats in the soil profiles.

As indicated previously, the subsoil and overburden is highly saline and in most instances fairly sodic. Destruction of existing soil-plant-water-topographic relationships may bring about a different set of relationships which might result in the upward migration of salts from regraded spoils and subsoils into topsoil. This would render the topsoil less favorable as a rooting medium due to the higher osmotic pressures of the soil solution and due to the possible adverse effects of sodium on soil physical properties.

Soil removal and handling will probably result in compaction and degradation of soil structure which would result in adverse effects on permeabilities to water and air and root penetration (U.S.D.I., and M.D.S.L., 1976). It will also expose the landscape to potential accelerated water and wind erosion until a

stable plant community can be established on regraded and retopsoiled spoils. Soil stockpiles may also be subject to erosion and may require stabilization by special configuration and/or by establishing a temporary vegetative cover. The problem be further limited by minimizing the extent and duration of stockpiling (U.S.D.I., and M.D.S.L., 1976).

Mining will expose deep lying geological strata to weathering which will cause changes in the chemical and physical charateristics of these materials. Analyses of trace mineral content in overburden provides little information on the dynamic nature of these elements after exposure of overburden to weathering (M.D.S.L., 1976).

4. Hydrology

Drainage will be maintained at all times. Drainages may be altered during or as a result of mining. Creation of ponds would be limited to no more than one per section.

B. Biological Environment

1. Vegetation

ACCo would reseed all areas disturbed by mining, planting a mixture of grasses and clover (Table 2). All newly seeded areas will be protected from grazing for two growing seasons to allow seedling establishment. Areas to be reclaimed as water retention sites will have the perimeter seeded with cattails.

While reclamation of bentonite pits in the Alzada area has enjoyed limited success, severe problems may be encountered. Historically stray seams of bentonite have been left near the surface resulting in a hostile area nearly sterile to vegetation. The Montana Open Cut Mining Act requires that these seams be buried under at least two feet of material suitable to plant growth. Newer mining

plans result in the burial of these materials at the base of the highwall or toe of the overburden deposition pile. Such burial requires diligence however. Even with the newer mining methods, stray seams may be left near the surface.

When bentonite is left near or mixed with topsoil, the resulting soil has physical characteristics detrimental to plant growth. Even when stray seams are buried, revegetation problems still occur in some areas as overburden is unsuitable to plant growth. Also any mixing encountered in topsoil salvage may result in topsoil unsuitable for plant growth.

Precipitation in the Alzada area is of a boom and bust nature with years of average precipitation being the exception rather than the rule (Appendix D). Successful reclamation has recently occurred in a period of near average or above average precipitation. Several years of significantly below normal precipitation could however cause reclamation failure.

Another problem historically encountered in bentonite reclamation is in deferring grazing. Livestock often graze (often overgraze due to the succulent nature of the plants) newly seeded areas with results ranging from the beneficial removal of weedy competition to the destruction of the seedlings. Ranchers in the Alzada area use large pastures (usually a section in size, but often several sections in size). Since bentonite companies often have intermingled claims there is frequently active mining occurring in many pastures and it is therefore difficult for a rancher in such areas to defer grazing in all pastures that contain within them newly seeded areas. Ultimately fencing of newly seeded areas may be required if successful revegetation is to occur.

Table 2.--Revegetation species

Western wheatgrass	6 lb. PLS*/acre
Green needlegrass	2 lb. PLS/acre
Yellow sweetclover	.5 lb. PLS/acre
Pubescent wheatgrass	2 lb PLS/acre
Streambank wheatgrass	.5 lb PLS/acre

*Pure live seed.

2. Wildlife

Although all disturbed areas would be reseeded, mitigating effects on wildlife would be minimal. The primary impact is due to the loss of sagebrush, and there would be no attempt to replace it. There would be some beneficial effect on waterfowl by the formation of ponds and seeding of shoreline vegetation.

C. Human Environment

1. Transportation

The use of haul roads would be limited to company owned vehicles.

2. Aesthetics

Where possible mounds and cuts would be contoured to fit into the surroundings. All road ditches would be reseeded.

3. Agricultural Production

Rangeland would be reseeded and would hopefully have a higher carrying capacity than it had previous to mining.

VIII. IRREVERSIBLE, IRRETRIEVEABLE COMMITMENTS OF ENVIRONMENTAL RESOURCES

Bentonite, being a non-renewable resource; once removed would not be renewed. The process is for all practicality irreversible. Surface productivity though sacrificed for mining in the short term can hopefully be restored through mitigation.

According to Battelle (1975) bentonite mining on the average consumes 218,000 Btu's per ton and hauling requires 68,000 Btu's per ton. These figures would require slight adjustments for application to the proposed ACCo operation since Alzada bentonite is shallower than average, and hauling distance would be longer than average. Battelle gives a figure of 1,963,000 Btu's as the amount of energy required for the total operation from mining through processing for one ton of bentonite.

IX. COMPARISON BETWEEN SHORT TERM COSTS AND LONG TERM PRODUCTIVITY

This comparison must necessarily be between the long term use of the land as range and short-term use for open pit mining. If reclamation is successful these two are not incompatible. At .3 AUM's per acre the permit area would support 445 AUM's. The area would be mined over a 5 year period. If it takes five years (hopefully a maximum figure) for complete reclamation, and if stock are removed for the entire period a loss of 4,550 AUM's would result. This should be a maximum figure. Given a total of 5000 tons/acre of bentonite (Robert Baker, ACCo Pers. Com.), if 30% of the area is mined a total of 2,227,500 tons of bentonite would be mined in this area (accuracy of estimate is unknown).

X. DESCRIPTION OF ALTERNATIVE ACTIONS

A. Denial of Permit

Denial of the permit would mean that ACCo would be forced to intensify mining in areas presently under permit. This action could have two negative results: 1) The ultimate closure of the Belle Fourche (South Dakota) processing plant. 2) Intensification of mining in less desirable locations with lower reclaimability (i.e. the Big Horn Basin area near Warren, Montana).

The positive aspect of denial of the permit would be that none of the adverse impacts would be realized.

B. Change of mining and/or Reclamation Plan

The mining plan could be altered to eliminate mounds and ponds. If the overburden from the first pit were stockpiled and placed in the final cut, the the topography would be returned to its original configuration.

C. Change method of mining

Presently no other reasonably economical, feasible methods of mining bentonite are known.

XI. SOURCE MATERIAL USED IN PREPARATION OF THE DRAFT ENVIRONMENTAL IMPACT STATEMENT

A. References

American Colloid Co., 1976, Reclamation Plan, Carter County, Montana - Open Cut Mine Contract Application.

Anon. 1972, Belle Fourche Salutes the Bentonite Industry, The Belle Fourche Daily Post, Vol. 70.

Battelle 1975, Energy Use Patterns in Metallurgical and Nonmetallic Mineral Processing Report to the U.S. Bureau of Mines.

Buckman, H. O. and N. C. Brady 1969, The Nature and Property of Soils Macmillan Co. NY 653 pp.

Buol, S. W., F. D. Hole, and R. J. McCracken 1973, Soil Genesis and Classification Iowa State Univ. Press: Ames, Iowa 360 pp.

Doering, E. J. and W. O. Willis 1975, Chemical Reclamation of Sodic Strip-Mine Spoils, U.S.D.A. ARS-NC-20: pp. 2-8.

Ecological Consulting Service 1975a, Wildlife and Wildlife Habitat, Four Season Baseline, Report to American Colloid Co. Project 85-23-A.

______________________________ 1975b, Vegetation Production condition and Community typing, Mining Areas A, B, and E. Report to Western Energy Co. Project 107.23A.

Eustace, C. D. 1971, Big Game Survey and Inventory (Deer) Montana Fish and Game Progress Report No. W-130-R-2, Job No 1-7.

Knechtel, M. M. and S. H. Patterson, 1962, Bentonite Deposits of the Northern Black Hills District, Wyoming, Montana and South Dakota, Geological Bullentin 1082-M U.S. Gov. Print. Office.

Lisk, D. J. 1972 Trace Metals in Soils, Plants and Animals, Advances in Agronomy 29: pp. 267 - 325.

Montana Department of Community Affairs, 1975, Carter County Profile, Division of Research and Information Systems, Helena, MT.

Montana Department of State Lands 1976, Final Environmental Impact Statement for the Proposed Expansion of Western Energy Company's Rosebud Mine into Area B, 153 pp.

Power, J. F., R. E. Ries, F. M. Sandoval, and W. O. Willis 1975, Factors Restricting Revetation of Strip Mine Spoils. In Proceedings of the Fort Union Coal Field Symposium, Billings, Montana. 3: pp. 336-346.

United State Department of Interior and Montana Department of State Lands, 1976, Draft Environmental Impact Statement of East Decker and North Extension Mines of Decker Coal Company, Vol. 1: 758 pp.

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B.S. Agricultural Business, 1974, Montana State University
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M.S., Resource Conservation, 1975, University of Montana.

Overton, Randy, Mine Inspector, Open Cut Bureau, DSL.
B.S., Forest Hydrology, 1974, University of Montana.

Woods, Mike, Geologist, Coal Bureau, DSL.
B.S., Geology, 1964, University of Pennsylvania
M.S., Geochemistry, 1970, Kansas State University
Ph.D., Geology, 1974, University of Montana.

C. Other Agencies Contacted

Carter County
Montana Department of Community Affairs
Montana Department of Natural Resources
Montana Department of Revenue
U.S. Bureau of Land Management
U.S. Soil Conservation Service

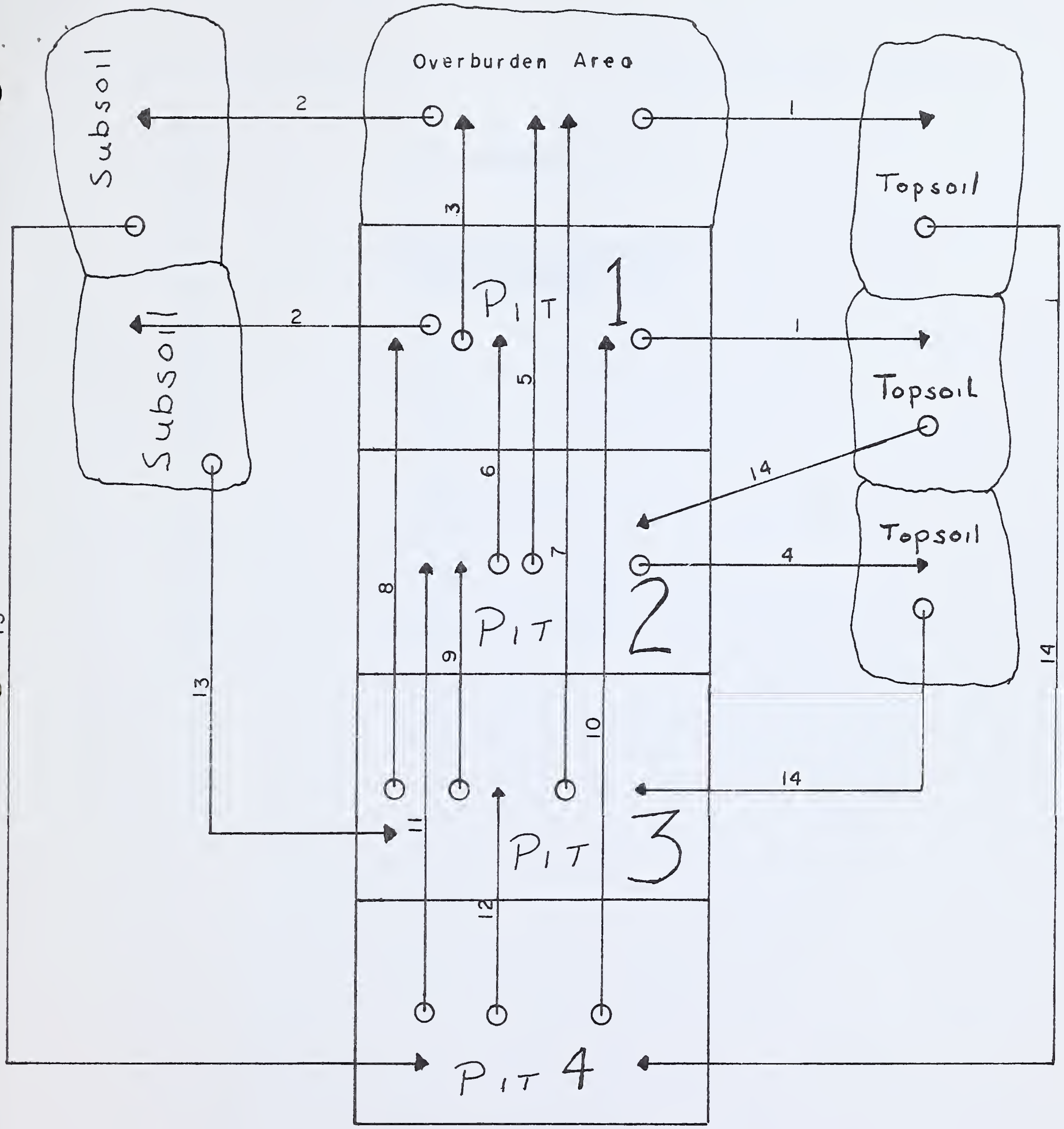
APPENDIX A

Sample Bentonite Mining Sequence Involving Four Pits

Sample mining sequence involving four pits.

Step:

1. Topsoil from pit one and overburden area is removed and stockpiled.
2. Subsoil from pit one and overburden area is removed and stockpiled.
3. Overburden from pit one is removed and placed in the overburden area. The bentonite is removed.
4. Topsoil from pit two is removed and stockpiled.
5. Subsoil from pit two is removed and spread on the overburden area.
6. Overburden from pit two is removed and placed in pit one. The bentonite is removed.
7. Topsoil from pit three is removed and spread on the overburden area.
8. Subsoil from pit three is removed and spread on pit one.
9. Overburden from pit three is removed and placed in pit two. The bentonite is removed.
10. Topsoil from pit four is removed and spread on pit one.
11. Subsoil from pit four is removed and spread on pit two.
12. Overburden from pit four is removed and placed in pit three. The bentonite is removed.
13. The stockpiled subsoil is spread on pits three and four.
14. The stockpiled topsoil is spread on pits two, three and four.

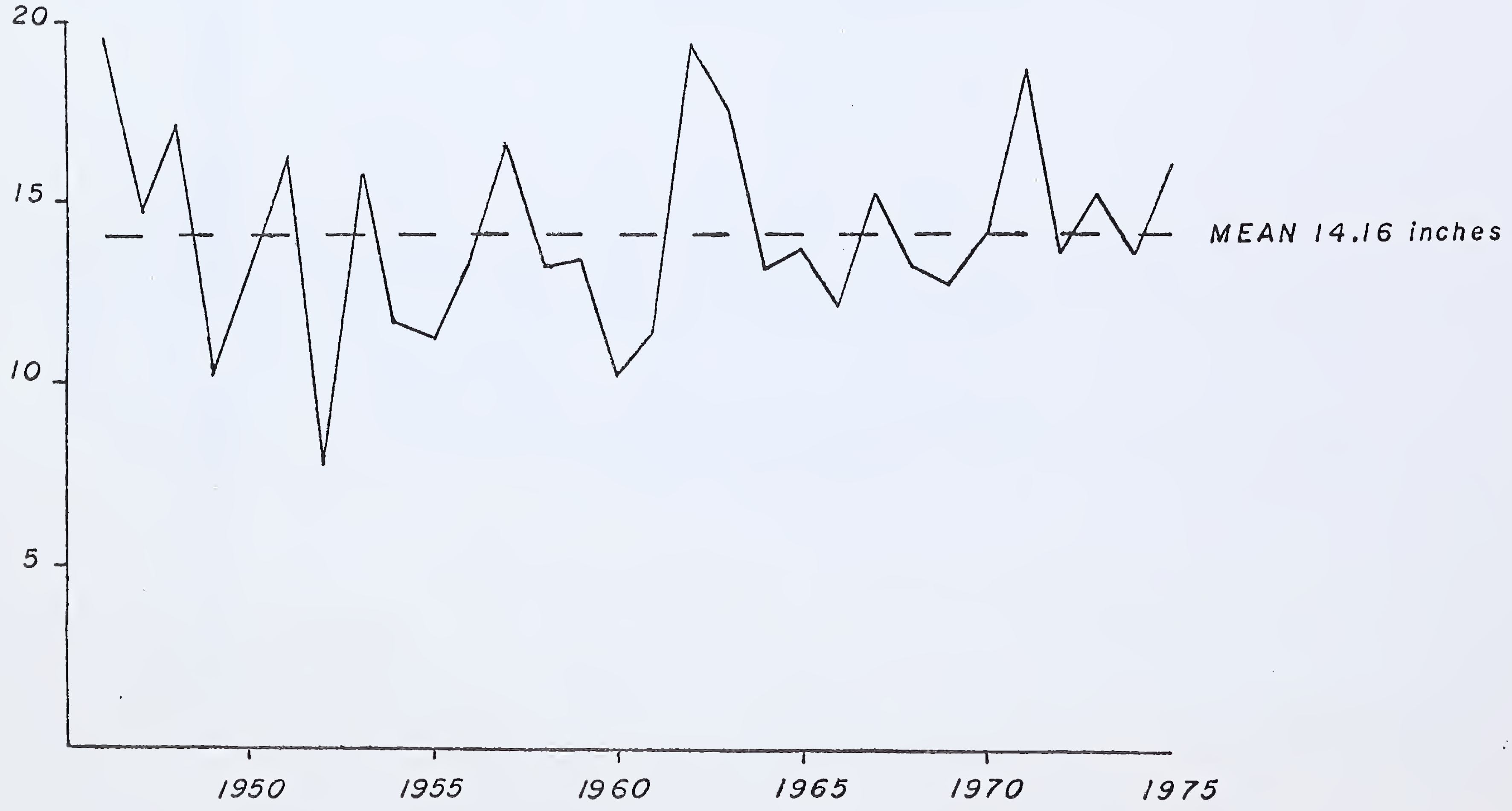

Overburden Area
Subsoil
Topsoil
Pit 1
Subsoil
Topsoil
Topsoil
Pit 2
Pit 3
Pit 4

APPENDIX B

Precipitation Data for the Alzada Montana Area

Appendix B.--Precipitation by year of Alzada (from the Albion weather station).

1975	16.04
1974	13.78
1973	16.12
1972	13.64
1971	18.83
1970	14.23
1969	12.90
1968	13.25
1967	15.20
1966	12.21
1965	13.71
1964	13.03
1963	17.49
1962	19.48
1961	11.43
1960	10.27
1959	13.65
1958	13.17
1957	16.66
1956	13.19
1955	11.25
1954	11.70
1953	15.71
1952	7.80
1951	16.03
1950	12.81
1949	10.05
1948	17.07
1947	14.82
1946	19.44



ANNUAL PRECIPITATION

APPENDIX C

Wildlife and Vegetation of the Alzada, Montana Area

Appendix C.--Vegetation of the Alzada Area*

	Scientific Name	Common Name
TREES:	*Acer negundo*	Boxelder
	Fraxinus pennsylvanica	Green ash
	Juniperus scopulorum	Rocky Mountain Juniper
	Pinus ponderosa	Ponderosa pine
	Populus deltoides	Plains cottonwood
	Quercus macrocarpa	Bur oak
SHRUBS:	*Artemisia tridentata*	Big sagebrush
	Atriplex nuttallii	Nuttall saltbush
	Chrysothamnus nauseosus	Rubber rabbitbrush
	Gutierrezia sarothrae	Broom snakeweed
	Rosa arkansana	Prairie rose
	Salix spp.	Willow
	Sarcobatus vermiculatus	Greasewood
	Symphoricarpos spp	Snowberry
GRASSES AND GRASS-LIKE PLANTS:	*Agropyron dasystachyum*	Thickspike wheatgrass
	Agropyron smithii	Western wheatgrass
	Agrostis spp	Bentgrass
	Andropogon scoparius	Little bluestem
	Aristida longiseta	Red three-awn
	Bouteloua gracilis	Blue grama
	Bromus inermis	Smooth brome
	Bromus japonicus	Japanese chess
	Bromus tectorum	Cheatgrass brome
	Buchloe dactyloides	Buffalograss
	Calamagrostis spp.	Reedgrass
	Calamovilfa longifolia	Prairie sand reedgrass
	Carex filifolia	Threadleaf sedge
	Carex viridula	Green sedge
	Carex spp.	Sedge
	Distichlis stricta	Inland saltgrass
	Koeleria cristata	Junegrass
	Muhlenbergia asperifolia	Alkali muhly
	Phleum pratense	Timothy
	Poa pratensis	Kentucky bluegrass
	Poa scabrella	Pine bluegrass
	Poa secunda	Sandberg bluegrass
	Spartina gracilis	Alkali cordgrass
	Stipa comata	Needle-and-thread
	Stipa viridula	Green needlegrass

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* Ecological Consulting Service 1975b.

	Scientific Name	Common Name
FORBS:	*Achillea millefolium*	Yarrow
	Androsace septentrionalis	Northern androsace
	Artemisia ludoviciana	Cudweed sagewort
	Aster spp.	Aster
	Astragalus spp	Milkvetch
	Compositae	--
	Eriogonum spp.	Eriogonum
	Grindelia squarrosa	Curlcap gumweed
	Kochia scoparia	Summer cypress, kochia
	Medicago lupulina	Black medic
	Medicago sativa	Alfalfa
	Mentha arvensis	Field mint
	Oenothera caespitosa	Tufted evening primrose
	Opuntia polycantha	Plains pricklypear
	Phlox hoodii	Hoods phlox
	Plantago purshii	Woolly plantain
	Ratibida columnifera	Prairie coneflower
	Sphaeralcea coccinea	Scarlet globemallow
	Taraxacum officinale	Common dandelion
	Tragopogon dubius	Common salsify
	Vicia americana	American vetch
	Zigadenus venenosus	Meadow death camas

Appendix B.--Mammals of the Alzada Area*

Scientific Name	Common Name
Antilocapra americana	Pronghorn antelope
Canis latrans	Coyote
Castor canadensis	Beaver
Erethizon dorsatum	Porcupine
Lepus townsendii	White-tailed jackrabbit
Lynx rufus	Bobcat
Mephitis mephitis	Striped skunk
Odocoileus hemionus	Mule deer
Odocoileus virginianus	White-tailed deer
Peromyscus maniculatus	Western deer mouse
Procyon lotor	Raccoon
Reithrodontomys megalotis	Western harvest mouse
Spermophilus tridecemlineatus	Thirteen-lined ground squirrel
Sylvilagus nuttalli	Mountain cottontail
Tamiasciurus hudsonicus	Red squirrel
Vulpes vulpes	Red fox

Appendix C.--Birds of the Alzada Area*

Scientific Name	Common Name
Agelaius phoeniceus	Red-winged blackbird
Anas acuta	Pintail
Anas discors	Blue-winged teal
Anas platyrhynchos	Mallard
Aquila chrysaetos	Golden eagle
Buteo jamaicensis	Red-tailed hawk
Buteo lagopus	Rough-legged hawk
Calamospiza melanocorys	Lark bunting
Centrocercus urophasianus	Sage grouse
Charadrius vociferus	Killdeer
Circus cyaneus	Marsh hawk
Colaptes cafer	Red-shafted flicker
Corvus brachyrhynchos	Common crow
Eremophila alpestris	Horned lark
Euphagus cyanocephalus	Brewer's blackbird
Falco sparverius	American kestrel
Hirundo rustica	Barn swallow
Mareca americana	American pidgeon
Meleagris gallopavo merriami	Merriam's turkey
Numenius americanus	Long-billed curlew
Parus artricapillus	Black-capped chickadee

* Ecological Consulting Service 1975a.

Scientific Name	Common Name
Pedioecetes phasianellus	.Sharp-tailed grouse
perdix perdix.	.Hungarian partridge
Phalacrocorax auritus.	.Double-crested cormorant
Phasianus colchicus.	.Pheasant
Pica pica.	.Magpie
Pooecetes gramineus.	.Vesper sparrow
Sialia currucoides	.Mountain bluebird
Spizella breweri	.Brewer's sparrow
Steganopus tricolor.	.Wilson's phalarope
Sturnella neglecta	.Western meadowlark
Turdus migratorius	.Robin
Tyrannus tyrannus.	.Eastern kingbird
Zenaidura macroura	.Mourning dove
Zonotrichia leucophrys	.White-crowned sparrow